Senior High School Curriculum Guide

for

SCIENCE 11

and

SCIENCE 32

(Biology)

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FOREWORD

Two courses in Biology are offered in the senior high school: Science 11 and Science 32.

Science 11 is intended mainly for students in their first or second year. It is not a prerequisite for Science 32. It may be offered for either three or four credits.

Science 32 is a senior course, available to students in Grade XII. It consists of a review of the four units of Science 11, and five additional units. It includes also extensive practice in laboratory work.

The outline of practical and experimental work for Biology 2 (Bulletin 5b) may be used as a guide for laboratory work in Science 32 during 1953-54. In September, 1954, it will be replaced by a new laboratory manual. In the meantime, teachers who wish to do so may substitute *A Laboratory Course in Biology* by J. G. Rempel (Ginn & Company) for Bulletin 5b.

ACKNOWLEDGMENT

The Department of Education acknowledges with appreciation the contributions of the following committee members for the preparation of this Senior High School Curriculum Guide for Biology. The guide has been prepared by the subcommittee on Biology under the guidance of the Senior High School Curriculum Committee.

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INTRODUCTION

SCIENCE OBJECTIVES IN GENERAL EDUCATION

The major purpose of education is to enable pupils to acquire those understandings, appreciations, attitudes, skills and methods of thought by means of which they can make satisfactory and effective adjustment to the natural and social environment. Science education should contribute to this purpose by:

1. Awakening and developing a variety of enduring challenging interests and satisfactions.
2. Creating an awareness of the existence of many problems for which solutions are needed.
3. Cultivating the ability and desire to apply scientific attitudes and methods to the solution of all problems.
4. Equipping individuals with the practical scientific knowledge and skills necessary to make effective adjustment to their environment.
5. Developing a functional understanding of the major concepts and generalizations of science.
6. Developing an appreciation of the contribution of science in modern life.

The study of biology should contribute to these objectives by helping the pupil to:

1. Develop an interest in his natural surroundings, and an appreciation of them.
2. Develop an appreciation of the contributions of biology to modern life.
3. Develop an understanding of those biological principles which are necessary for effective social adjustment.
4. Develop skill in observing and interpreting biological phenomena.
5. Develop an increasing sense of personal responsibility for his own health and the health of the community.
6. Discover the vocational possibilities of biology.
7. Develop those activities which will promote worthy use of leisure time.

SUGGESTIONS TO THE TEACHER

In developing the biology course around the practical aspects of daily living it is essential that the teacher:

1. Use live materials wherever possible.
2. Use familiar organisms—local flora and fauna.
3. Avoid too much emphasis on technical terms. They should be tools, not an end in themselves.
4. Use varied methods, techniques, and content.
5. Explore and experiment along with the pupils.
6. Use seasonal material.
7. Emphasize the consumer aspects of life.
8. Emphasize health when it comes in naturally in the content being studied.
9. Seek to develop an understanding of the major principles of life.
10. Strive to realize the objectives of science instruction.

UNIT CONSTRUCTION

Each unit is built around a major generalization of biology. The teacher should follow the order of units best suited to the particular situation rather than the order in which they are listed.

An explanation of the "principles" method may be desirable. Important ideas or important principles are selected and stated as themes. Then appropriate type forms, groups, and activities are selected from the wide field of biology to illustrate the principles. Pupils cannot remember the isolated facts of biology, but they should marshal facts back of conclusions and principles which they can remember and use as guides in their thinking. The strength of the method is that it throws emphasis where value is greatest. It does have weaknesses. Principles are elusive and attempts to present them leave the class discouraged unless the presentation is preceded or accompanied by concrete illustrative material. However, if the generalizations grow out of experience with concrete, familiar materials then this weakness ceases. The better aspects of the types and systematic methods are included in the present course outlines.

SCIENCE 11

References

PRIMARY REFERENCE

**Biology in Daily Life,* Curtis and Urban

SECONDARY REFERENCES

Adventures with Plants and Animals, Kroeber and Wolff

Elements of Biology, Dodge, Smallwood, Reverley, Bailey

OTHER REFERENCES FOR THE ROOM LIBRARY

Native Trees of Canada (Queen's Printers, Ottawa)

Natural History Magazine (American Museum of Natural History, 79 St. at Central Park West, New York 24)

Animals Without Backbones, Buchsbaum (University of Chicago Press)

One or more field books, such as *Field Book of Natural History,* Palmer (McGraw-Hill)

Bulletins published by the Dominion and Provincial Governments.

Many other excellent references are listed at the ends of the chapters in the textbook.

***Note:**

While no other book is authorized or needed as a primary reference for this course, teachers who wish to provide themselves with any of the following may have them specially ordered by the School-Book Branch:

Workbook to accompany *Biology in Daily Life*
Tests in Biology to accompany *Biology in Daily Life*
Teachers' Manual and Key for *Biology in Daily Life*

SCIENCE 11: UNIT I—A SURVEY OF LIVING THINGS

OBJECTIVES

1. To give pupils an overview of the field of biology.
2. To give pupils an awareness of the interdependence of living things.
3. To give the teacher an opportunity to ascertain the interests and aptitudes of his pupils.
4. To utilize the living things found abundantly in the community.
5. To enable the pupils to become acquainted with the living things in their locality.

GENERALIZATIONS

1. All living things are interdependent with their living and physical environment.
2. The basic aspects of living—nutrition, protection, and reproduction—are responsible for this interdependence.
3. Life exists wherever conditions such as food, water, oxygen and certain limits of temperature and pressure are favorable.
4. Life, matter and energy follow cycles involving change but no loss or creation.
5. The balance of nature is ever changing.

Understandings	Suggested Scope and Procedures
1. All living things are engaged in a struggle for energy.	Field trips may be taken to woods, parks, school grounds to observe typical habitats and relationships. Pond life is of particular interest. Interesting materials from the immediate locality may be brought into the schoolroom if field trips are not feasible.
a. Green plants and a few bacteria can convert radiant energy into chemical energy of foods.	Emphasize that these are the only organisms that can make food from inorganic matter. Details of the process will be dealt with in Unit II.
b. Some organisms gain energy from other living things.	Make a survey of the parasites typical of the school locality such as insects and fungi.
c. Some organisms gain energy from things which have lived.	Make a survey of saprophytes of the locality: mushrooms, molds, bacteria of decay, etc.
d. Some living things live in close association and are mutually helpful.	Study a few relationships such as lichens, ants and aphids.
e. Many living things obtain protection by living in close proximity to other living things.	Study a few commensal relationships: spider crab and hydroid, remora and shark, a small crab and sponge.
f. Some organisms live by preying on others.	Survey predators of the locality and study some of their adaptations.
g. There is a delicate balance between independent, parasitic, saprophytic, symbiotic, commensal, and predatory organisms which, if disturbed even slightly, becomes upset.	Study some plant-animal society. Note some food chains and food pyramids. Consider how the balance has been upset by man's activities: farming, draining swamps, building dams, deforestation, hunting, introduction of new species, control of predators, etc.

Understandings	Suggested Scope and Procedures
h. There is a limited quantity of nutritional material on the earth, so there must be a "cycle of life"; in other words, some organisms must die that others may live.	Develop schematic representations of the cycles of living forms, matter, and energy.
2. A locality restricts the kinds of life which can survive there.	Identify the factors or conditions that determine the abundance of living things. Make a survey of organisms of the school locality. Learn the common names of some and how to identify them.
a. There are impassable barriers which bar some forms of life from our region.	Select some plant-animal society and try to identify the factors and adaptations which make it possible for each member to retain its place in the society.
b. Some forms of life are typical of our immediate locality while other forms may thin out, or increase, or be stunted, or become more luxuriant as we travel out from our locality.	If possible observe succession on an abandoned or burned-over area, or due to drought, or acid or alkaline soil. Study the geographic distribution of some organisms in a general way. Note some with a wide range, and some with restricted range. Try to find local examples.
c. Those organisms best survive which have adaptations fitting them for the area in which they live.	Study adaptations of local plants for seed dispersal, anchoring, obtaining and retaining moisture.
d. Under domestication it is often possible to shift the balance of life in such a way that only the most useful, the most beautiful or the most interesting organisms can survive.	If desirable, make a study of a few domesticated plants and animals—origin, optimum conditions for growth, etc.
3. Organisms are classified and given scientific names on the basis of relationship determined from similarity of structure.	Study the Linnaean system—Kingdom, Phylum, Class, Order, Family, Genus, Species. Classify a few familiar organisms to illustrate how it is done. Emphasize how a scientific name is written.

REFERENCES

Biology in Daily Life, pp. 17-57; 511-569.

Adventures with Plants and Animals, pp. 14-103.

Elements of Biology, pp. 4-36.

SCIENCE 11: UNIT II—GREEN PLANTS MAKE THE FOOD USED BY ALL LIVING THINGS

OBJECTIVES

1. To give pupils a functional understanding of the energy transformations in a green plant.
2. To acquaint pupils with the basic structure of plants.

GENERALIZATIONS

1. The sun is the source of all energy used by living things on earth.
2. Green plants can transform the radiant energy of sunlight into chemical energy of foods.
3. Matter and energy cannot be created or destroyed. They can only be changed from one form into another.
4. The cell is the unit of structure of all living things.
5. The size and shape of cells vary according to function.

Understandings	Suggested Scope and Procedures
1. The leaf is a wonderful food factory.	Report on Van Helmont and his willow tree.
2. Food is manufactured in parts of the leaf called cells.	Observe the structure of a leaf under the microscope.
3. Cells in other parts of the plant are adapted to the work they do.	Observe the general structure of roots and stems under the microscope. Note the transporting system.
4. The leaf factory needs certain essentials in order to carry on its work.	Compare photosynthesis to a factory process. Observe the structures and processes involved in getting water and carbon dioxide.
	Demonstrate diffusion and osmosis.
	Observe arrangement of leaves with respect to sunlight.
	Demonstrate that sunlight and chlorophyll are essential in order that the process of photosynthesis may go on.
5. Carbohydrates are the first products synthesized by plants.	Demonstrate the presence of starch in green leaves that have been in sunlight.
6. Plants can convert carbohydrates into other forms of food such as proteins and oils, cellulose.	Experiment to discover what elements are essential in plant nutrition.
	Make laboratory tests of fruits, seeds, roots, stems to discover what forms of food are present.
	If feasible, observe processing of plant products on the farm or in the factory.
	Learn to identify local trees and other useful plants.

REFERENCES

Biology in Daily Life, pp. 146-196.

Adventures with Plants and Animals, pp. 136-165.

Elements of Biology, pp. 473-509.

SCIENCE 11: UNIT III—FOOD AND METABOLISM

OBJECTIVES

1. To give pupils a functional understanding of the life processes involved in metabolism.
2. To give pupils an awareness of the important factors of a well-balanced diet.
3. To create an appreciation of the value of good health habits in the prevention of organic disorders.

GENERALIZATIONS

1. There is a constant building up and tearing down within the body of every living organism.
2. All organisms transform energy of foods into other energy such as chemical, heat, mechanical energy.
3. The health of an individual depends upon the wise selection of food.
4. All organisms have adaptations for getting food.
5. All organisms have means of converting food into soluble form.
6. Food and oxygen must be made available to all parts of every organism.
7. The toxins which are constantly being formed as a result of metabolism must be eliminated from the organism.
8. Cells have the ability to select from their environment those substances with which they carry out their particular function.
9. All plants and animals are basically alike.
10. The more complex the organism the more complex its structures for carrying out each metabolic process.

Understandings	Suggested Scope and Procedures
1. Our health depends on a wise selection of foods.	Study types of foods and their composition. Study the factors determining the dietary requirements of humans.
a. Important factors of a well-balanced diet include calories, proteins, fats, carbohydrates, vitamins, minerals, roughage and water.	Have each pupil determine his own dietary requirements and, using tables in a text-book, devise a diet for a day or a week that will meet these requirements. Report on discovery of some of the vitamins.
b. Diagnosis, medication and advice is the function of the licensed physician.	Analyze some food fads and advertisements.
c. Deficiency diseases.	Study some sources and effects of deficiency of vitamins A, C, D, K, Thiamin and Riboflavin, Niacin. If feasible, experiment with white rats or other small animals to observe the effects of vitamin or other dietary deficiencies. Films also will be very helpful.
d. Selection of an adequate diet can be made within the range of a limited budget.	Have each pupil make a diet for himself keeping within set limits of cost.

Understandings	Suggested Scope and Procedures
2. All organisms have special adaptations for getting and holding food.	Observe how some animals get and hold food: ameba, paramecium, or other protozoans in pond water; fish, etc., in aquarium; earthworm, various insects, frog, snake, various birds and mammals that can be observed locally.
3. All organisms have means of converting food into soluble form.	Study the digestive system in man—parts, enzymes, their sources and effects on food. Demonstrate the effects of ptyalin, pepsin and trypsin, and pancreatin on food. Study absorption of digested foods into the blood stream. Observe peristaltic movement in a round worm. Demonstrate digestion in plants, diastase on starch, and protease on gelatin. Report on one or more insectivorous plants. Compare digestion in ameba or paramecium, hydra, earthworm, grasshopper, frog and cow or sheep.
4. Food and oxygen must be made available to every cell of every organism.	Observe pulse while sitting, standing, exercising. Examine blood under microscope. Study composition of the blood. If feasible, observe circulation in tail of a small fish or toe web of a frog. Observe heart beat in a small animal such as a water flea. Study main parts and circuit of blood in human circulatory system. Compare circulation in earthworm, grasshopper, fish. Examine a bird or mammalian heart.
5. Cells have the ability to select from their environment those substances which they require for respiration and assimilation.	Study interchange of materials between blood and the cells. Compare respiration and photosynthesis.
6. Complex organisms have special adaptations for getting a supply of oxygen to every cell.	Observe lungs of some animal. Demonstrate breathing mechanism with a bell jar and toy balloons. Observe effect of exercise on rate of breathing. Compare the methods of aeration in a protozoan, earthworm, fish and bird. Demonstrate respiration in germinating seeds.
7. The toxins which are constantly being formed as a result of metabolism must be eliminated from the organism.	Study the excretory system in man. Compare with excretion in a protozoan.

REFERENCES

Biology in Daily Life, pp. 197-276.
Adventures with Plants and Animals, pp. 167-259.
Elements of Biology, pp. 293-348.

SCIENCE 11: UNIT IV—CONSERVATION OF LIFE

OBJECTIVES

1. To give pupils a functional understanding of the dependence of man upon the material and living environment.
2. To develop an appreciation of the contributions of scientists to our present knowledge of our environment and its control.
3. To create an awareness of personal and community health problems.
4. To develop an appreciation of our resources and an awareness of the need for conservation.

GENERALIZATIONS

1. Man's welfare depends upon his ability to control his environment.
2. Micro-organisms have a wider range of habitat than any other living thing.
3. Most micro-organisms are harmless and many are helpful.
4. Communicable diseases are due to specific micro-organisms or viruses.
5. The control of infection depends upon a knowledge of how the disease is spread and of available preventive and therapeutic measures.
6. Individual welfare requires the organized help and co-operation of each member of the community.
7. Man is the most disturbing factor in the conservation of biological resources.

Understandings	Suggested Scope and Procedures
1. Man makes use of his knowledge of micro-organisms in controlling his environment.	
a. Micro-organisms play an essential role in certain industries.	Study the part micro-organisms play in making bread, cheese, vinegar, linen, leather and tobacco.
	Observe nodules on roots of legumes.
b. Micro-organisms play an essential role in maintaining soil fertility.	Study and diagram the carbon and nitrogen cycles. Discuss the construction and use of compost piles.
c. Some micro-organisms cause disease in plants and animals, including man.	Observe and study some plant diseases prevalent in the community such as cereal rust, smut, ergot, etc.
	Report on foot-and-mouth disease, rabies, or other diseases of current interest.
d. Man has learned to prevent and control many infectious diseases.	Grow some bacteria on culture plates. Determine conditions that favor growth, and the effects of antiseptics.
	Report on immunization and treatment of prevalent diseases.
e. Micro-organisms create some community problems.	Study measures taken to assure a safe water and milk supply, sanitary handling of foodstuffs, disposal of garbage and sewage.
2. Plants and animals are directly or indirectly dependent on the soil.	

Understandings	Suggested Scope and Procedures
a. Soil is formed by the weathering of rocks.	Study samples of types of soil found in the school locality. Make a soil map of Alberta. Experiment to determine the amount of water each type of soil will hold, and the effect of various soil conditioners.
b. Plants grow successfully only in topsoil.	If feasible, experiment with growing plants in different types of soil and sub-soil.
c. Erosion removes the most fertile soil.	Study causes of erosion and practices which aggravate it. Study methods used in Alberta to prevent or minimize erosion.
3. Man requires an understanding of the life cycles and habits of insects in order to control his environment.	Study the life cycles of a few helpful insects of the locality. Study the life cycles of the chief insect pests of the locality—the harm they do and the methods used to control them: wheat-stem sawfly, cutworm, grasshopper, mosquito, housefly.
4. Birds are an important factor in reducing the number of plant and animal pests.	Study some of the common birds of the locality—how to recognize them, their importance, and steps taken to conserve them. Report on some birds that have become extinct or are in danger of becoming so.
5. Wild life of Western Canada was once a valuable natural resource. Control measures are required to save many species from extinction.	Report on fur-bearing mammals, past and present. Report on game mammals, and laws that protect them. Report on predatory animals and measures taken to control them.
6. The development and use of water resources has made many streams unfit for fish life by (a) stream pollution, (b) construction of dams and diversion of water for irrigation and power.	Draw a map showing the drainage of Alberta. Report on irrigation projects in Alberta. Study the causes and effects of stream pollution. Report on how building of dams has adversely affected water life and what measures have been taken to remedy the situation: fish ladders, hatcheries, closed streams, fishing laws.
7. Forests are valuable natural resources and must be conserved. Save the forests and you save the water, soil and wild life.	Study the location of Alberta's forest. Study the kinds of forest trees that grow in Alberta and their uses. Report on the value of forests—lumber, flood prevention, erosion control, etc. Study local damage to trees caused by insects and fungi, and the control measures employed. Note control by parasites and predators. Report on damage by forest fires. Report on work of East Slope Conservation Board, Forest Fire Control, Reforestation, controlled lumbering.

REFERENCES

Biology in Daily Life, pp. 64-145; 277-288; 303-324.

Adventures with Plants and Animals, pp. 373-409.

Elements of Biology, pp. 633-657.

SCIENCE 32

References

PRIMARY REFERENCE

**Biology in Daily Life,* Curtis and Urban

SECONDARY REFERENCES

Elements of Biology, Dodge, Smallwood, Reverley, Bailey

Exploring Biology, Ella Thea Smith

Modern Biology, Moon, Man and Otto

A Laboratory Course in Biology, J. G. Rempel

OTHER REFERENCES FOR THE ROOM LIBRARY

Native Trees of Canada (Queen's Printer, Ottawa)

Natural History Magazine (American Museum of Natural History, 79 St. at Central Park West, New York 24)

Animals Without Backbones, Buchsbaum (University of Chicago Press)

One or more field books, such as *Field Book of Natural History,* Palmer (McGraw-Hill)

Bulletins published by the Dominion and Provincial Governments.

Many other excellent references are listed at the ends of the chapters in the textbooks.

A list of available films will be found with the specific references at the end of each of the unit outlines following.

*Note:

While no other book is authorized or needed as a primary reference for the course, teachers who wish to provide themselves with any of the following may have them specially ordered by the School-Book Branch:

Workbook to accompany *Biology in Daily Life.*

Tests in Biology to accompany *Biology in Daily Life.*

Teachers' Manual and Key for *Biology in Daily Life.*

SCIENCE 32: UNIT I—A SURVEY OF LIVING THINGS

OBJECTIVES

1. To give pupils an overview of the field of biology.
2. To give pupils an awareness of the interdependence of living things.
3. To give the teacher an opportunity to ascertain the interests and aptitudes of the pupils.
4. To utilize the living things found abundantly in the community.
5. To enable the pupils to become acquainted with the living things in their locality.

GENERALIZATIONS

1. All living things are interdependent with their living and physical environment.
2. The basic aspects of living—nutrition, protection, and reproduction—are responsible for this interdependence.
3. Life exists wherever conditions such as food, water, oxygen, and certain limits of temperature and pressure are favorable.
4. Life, matter, and energy follow cycles involving change but no loss or creation.
5. The balance of nature is ever changing.

Understandings	Suggested Scope and Procedures
1. All living things are engaged in a struggle for energy:	Study life in a pond: macro and microscopic.
a. Green plants and a few bacteria can convert radiant energy into chemical energy of foods.	Emphasize that these are the only organisms that can make food from inorganic matter. Details of the process will be dealt with in Unit Two.
b. Some organisms gain energy from other living things.	Study some parasites typical of the school locality such as insects and fungi.
c. Some organisms gain energy from things which have lived.	Study some saprophytes of the locality: mushrooms, molds, bacteria of decay, etc.
d. Some living things live in close association and are mutually helpful.	Study a few relationships such as lichens, ants and aphids.
e. Many living things obtain protection by living in close proximity to other living things.	Study a few commensal relationships: spider crab and hydroid, remora and shark, a small crab and sponge.
f. Some organisms live by preying on others.	Study some predators of the locality and study some of their adaptations.
g. There is a delicate balance between independent, parasitic, saprophytic, symbiotic, commensal, and predatory organisms which, if disturbed even slightly, becomes upset.	Study some plant-animal society. Note some food chains and food pyramids. Consider how the balance has been upset by man's activities: farming, draining swamps, building dams, deforestation, hunting, introduction of new species, control of predators, etc.
h. There is a limited quantity of nutritional material on the earth so there must be a "cycle of life"; in other words, some organisms must die that others may live.	Develop schematic representations of the carbon and nitrogen cycles.
2. A locality restricts the kinds of life that can survive there.	Identify the factors or conditions that determine the abundance of living things.
a. There are impassable barriers which bar some forms of life from our region.	Select some plant-animal society and try to identify the factors and adaptations which make it possible for each member to retain its place in the society.
b. Some forms of life are typical of our immediate locality while other forms may thin out, or increase, or be stunted, or become more luxuriant as we travel out from our locality.	If possible, observe succession on an abandoned or burned-over area, or one due to drought, or acid or alkaline soil. Study the geographic distribution of some organisms in a general way. Note some with a wide range, and some with restricted range. Try to find local examples.
c. Those organisms best survive which have adaptations fitting them for the area in which they live.	Study adaptations of local plants for seed dispersal, anchorage, and for obtaining and retaining moisture.

Understandings	Suggested Scope and Procedures
d. Under domestication it is often possible to shift the balance of life in such a way that only the most useful, the most beautiful or the most interesting organisms can survive.	Observe how this has been done in the case of at least one plant and one animal.
3. Organisms are classified and given scientific names on the basis of relationship determined from similarity of structure.	Study the Linnaean system: Kingdom, Phylum, Class, Order, Family, Genus, Species. Classify a few familiar organisms to illustrate how it is done. Emphasize how a scientific name is written.

REFERENCES

Biology in Daily Life, pp. 17-57; 511-569.
Elements of Biology, pp. 4-36.
Exploring Biology, pp. 5-112.
Modern Biology, pp. 53-86.

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

T858 Introduction to Biology
T678 The Cell
T585 Life in a Drop of Water
T501 Mammals of the Western Plains
T500 Mammals of the Rocky Mountains
T463 Pond Insects
T461 How Nature Protects Animals
T441 Life in the Balance

SCIENCE 32: UNIT II—CONSERVATION OF LIFE

OBJECTIVES

1. To give pupils a functional understanding of the dependence of man upon the material and living environment.
2. To develop an appreciation of the contributions of scientists to our knowledge of our environment and its control.
3. To create an awareness of personal and community health problems.
4. To develop an appreciation of our resources and an awareness of the need for conservation.

GENERALIZATIONS

1. Man's welfare depends upon his ability to control his environment.
2. Micro-organisms have a wider range of habitat than any other living thing.
3. Most micro-organisms are harmless and many are helpful.
4. Communicable diseases are due to specific micro-organisms or viruses.
5. Individual welfare requires the organized help and co-operation of each member of the community.
6. Man is the most disturbing factor in the conservation of biological resources.

Understandings	Suggested Scope and Procedures
1. Man makes use of his knowledge of micro-organisms in controlling his environment.	
a. Micro-organisms play an essential role in certain industries.	Study the part micro-organisms play in making bread, cheese, vinegar, linen, leather and tobacco.
b. Micro-organisms play an essential role in maintaining soil fertility.	Observe nodules on roots of legumes. Study and diagram the carbon and nitrogen cycles. Discuss the construction and use of compost piles.
c. Some micro-organisms cause disease in plants and animals, including man.	Observe and study some plant diseases prevalent in the community, such as cereal rust, smut, ergot. Report on foot-and-mouth disease, rabies, or other diseases of current interest.
2. Plants and animals are directly or indirectly dependent on the soil.	
a. Soil is formed by the weathering of rocks.	Make a soil map of Alberta. Experiment to determine the amount of water each type of soil will hold, and the effects of soil conditioners.
b. Plants grow successfully only in topsoil.	Experiment with growing plants in different types of soil and subsoil.
c. Erosion removes the most fertile soil.	Study causes of erosion and practices which aggravate it. Study methods used in Alberta to prevent or minimize erosion.

Understandings	Suggested Scope and Procedures
3. Man requires an understanding of the life cycles and habits of insects in order to control his environment.	Study the life cycles of a few helpful insects of the locality. Study the life cycles of the chief insect pests of the locality—the harm they do and the methods used to control them: wheat-stem sawfly, cutworm, grasshopper, mosquito, housefly, etc.
4. Birds are an important factor in reducing the number of plant and animal pests.	Study some of the common birds of the locality—how to recognize them, their importance, and steps taken to conserve them. Report on some birds that have become extinct or are in danger of becoming so.
5. Wild life of western Canada was once a valuable natural resource. Control measures are required to save many species from extinction.	Fur-bearing animals, past and present. Game animals, and laws that protect them. Predatory animals and measures taken to control them.
6. The development and use of water resources has made many streams unfit for fish life by (a) stream pollution, (b) construction of dams and diversion of water for irrigation and power.	Report on irrigation projects in Alberta. Study the causes and effects of stream pollution. State how building of dams has adversely affected water life, and what measures have been taken to remedy the situation: fish ladders, hatcheries, closed streams, fishing laws.
7. Forests are valuable natural resources and must be conserved. Save the forests and you save the water, soil, and wild life.	Study the kinds of forest trees that grow in Alberta, and their uses. Note the value of forests: lumber, flood prevention, erosion control, etc. Study local damage to trees caused by insects and fungi, and the control measures employed. Note control by parasites and predators. Note work of East Slope Conservation Board, Forest Fire Control, reforestation, controlled lumbering.

REFERENCES

Biology in Daily Life, pp. 64-145
Elements of Biology, pp. 633-657.
Exploring Biology, pp. 505-562.
Modern Biology, pp. 669-696.

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

T870	Birds of Canada
Tk861	Your Forest Heritage
T810	What Is Soil? (Elementary)
Tk697	Green Acres (Conservation in Alberta)
T692	Facts About Fish
Tk634N	Vegetable Insects
T601	Ants

Tk570	Red Runs the Fraser (Salmon)
T523	The Life Cycle of the Mosquito
T505	Our Soil Resources
T496	Plant Traps
T439	Soil and Life
T432	Aphids
T429	Wearing Away the Land
T264	Soil for Tomorrow

SCIENCE 32: UNIT III—GREEN PLANTS MAKE THE FOOD USED BY ALL LIVING THINGS

OBJECTIVES

1. To give the pupils a functional understanding of the energy transformations in the green plant.
2. To acquaint pupils with the basic structure of plants.

GENERALIZATIONS

1. The sun is the source of all energy.
2. Green plants can transform the radiant energy of sunlight into chemical energy of foods.
3. Matter and energy cannot be created or destroyed. They can only be changed from one form into another.
4. The cell is the unit of structure of all living things.
5. The size and shape of cells vary according to function.

Understandings	Suggested Scope and Procedures
1. The leaf is a wonderful food factory.	Report on Van Helmont and his willow tree.
2. Food is manufactured in parts of the leaf called cells.	Observe the structure of a leaf under the microscope.
3. Cells in other parts of the plant are adapted to the work they do.	Observe the structure of roots and stems under the miscroscope. Note the transporting system.
4. The leaf factory needs certain essentials in order to carry on its work.	Compare photosynthesis to a factory process. Observe the structures and processes involved in getting water and carbon dioxide. Demonstrate diffusion and osmosis. Observe arrangement of leaves with respect to sunlight. Demonstrate that sunlight and chlorophyll are essential in order that the process of photosynthesis may go on.
5. Carbohydrates are the first products synthesized by plants.	Demonstrate the presence of starch in green leaves that have been in sunlight. Learn the chemical equation for the reaction.
6. Plants can convert carbohydrates into other forms of food such as proteins, oils, and cellulose.	Experiment to discover what elements are essential in plant nutrition. Make laboratory tests of fruits, seeds, roots, stems to discover what forms of food are present.

REFERENCES

Biology in Daily Life, pp. 197-276.
Elements of Biology, pp. 293-348.
Exploring Biology, pp. 201-216.
Modern Biology, pp. 444-513

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

Tk670B The Gift of the Green
T390N Plant Growth
T100 Leaves

SCIENCE 32: UNIT IV—FOODS AND METABOLISM

OBJECTIVES

1. To give pupils a functional understanding of the life processes involved in metabolism.
2. To give pupils an awareness of the important factors of a well-balanced diet.
3. To create an appreciation of the value of good health habits for the prevention of organic disorders.

GENERALIZATIONS

1. There is a constant building up and tearing down within the body of every living organism.
2. All organisms transform energy of foods into other energy such as chemical, heat, mechanical energy.
3. The health of an individual depends upon the wise selection of foods.
4. All organisms have adaptations for getting food.
5. All organisms have means of converting food into soluble form.
6. Food and oxygen must be made available to all parts of every organism.
7. The toxins which are constantly being formed as a result of metabolism must be eliminated from the organism.
8. Cells have the ability to select from their environment those substances with which they carry out their particular function.
9. All plants and animals are basically alike.
10. The more complex the organism the more complex its structures for carrying out each metabolic process.

Understandings	Suggested Scope and Procedures
1. Our health depends on a wise selection of foods.	
a. Important factors of a well-balanced diet include calories, proteins, fats, carbohydrates, vitamins, minerals, roughage, and water.	Study types of food and their composition. Study the factors determining the dietary requirements of humans. Report on discovery of some of the vitamins.
b. Diagnosis, medication and advice are the function of the licensed physician.	Analyze some food fads and advertisements.
c. Deficiency diseases.	Study some sources of vitamins A, C, D, K, Thiamin and Riboflavin, Niacin, and some effects of their deficiency. If feasible, experiment with white rats or other small animals to observe the effects of vitamin or other dietary deficiency. Films also will be very helpful.
d. Selection of an adequate diet can be made within the range of a limited budget.	Have each pupil make a diet for himself, keeping within set limits of cost.

Understandings	Suggested Scope and Procedures
2. All organisms have special adaptations for getting and holding food.	Observe how some animals get and hold food: ameba, paramecium, or other protozoans in pond water; fish, etc., in aquarium; earthworm, insects, frog, snake, various birds and mammals that can be observed locally.
3. All organisms have means of converting food into soluble form.	Study the digestive system in man: parts; enzymes, their sources and effects on food. Demonstrate the effects of ptyalin, pepsin or trypsin, and pancreatin, on food. Study absorption of digested foods into the blood stream. Observe peristaltic movement in a round worm. Demonstrate digestion in plants: diastese on starch and protease on gelatin. Report on one or more insectivorous plants. Compare digestion in ameba or paramecium, hydra, earthworm, grasshopper, frog, and cow or sheep.
4. Food and oxygen must be made available to every cell of every organism.	Observe pulse while sitting, standing, exercising. Examine blood under microscope. Study composition of the blood. If feasible, observe circulation in tail of a small fish or toe web of a frog. Observe heart beat in a small animal such as a water flea. Study main parts and circuit of blood in human circulatory system. Compare circulation in earthworm, grasshopper, fish. Examine a bird or mammalian heart.
5. Cells have the ability to select from their environment those substances which they require for respiration and assimilation.	Study interchange of materials between blood and the cells. Compare respiration and photosynthesis.
6. Complex organisms have special adaptations for getting a supply of oxygen to every cell.	Observe lung of some animal. Demonstrate breathing mechanism with a bell jar and toy balloons. Observe effect of exercise on rate of breathing. Compare the methods of aeration in a protozoan, earthworm, insect, fish, and bird. Demonstrate respiration in germinating seed.
7. The toxins which are constantly being formed as a result of metabolism must be eliminated from the organism.	Study the excretory system in man. Compare with excretion in a protozoan, earthworm, grasshopper, and frog.

REFERENCES

Biology in Daily Life, pp. 197-276.
Elements of Biology, pp. 293-348.
Exploring Biology, pp. 201-216.
Modern Biology, pp. 444-513.

FILMS

(Available from the Audio-Visual Aids Branch, Department of Education)

T720N	Vitamin D
Tk701	Digestion (Muscular)
Tk702	Digestion (Chemical)
Tk666	Circulation of the Blood
T651	Elimination
T602	Amoeba
T569	Paramecium
T571	The Earthworm (two reels)
T519	Life of a Freshwater Polyp
T341N	Vitamins A, B, C, and D
T206	The Heart and Circulation
T182	Mechanism of Breathing
T145	Foods and Nutrition

SCIENCE 32: UNIT V—THE CONQUEST OF DISEASE

OBJECTIVES

1. To give pupils an understanding of the causes and nature of important germ and non-germ diseases.
2. To give pupils an understanding of the body's natural defences against disease.
3. To give pupils an appreciation of the contribution of scientists to the conservation of human life through the prevention and treatment of diseases.

GENERALIZATIONS

1. All living things are subject to diseases.
2. Some diseases of plants and animals are caused by parasites; others are caused by dietary deficiencies; others are caused by glandular unbalance; and others by allergies and wearing out of organs.
3. Living things, by their life activities, affect the welfare of other living things.
4. Every kind of plant and animal has enemies, and only those that are able to avoid or resist the attacks of enemies live long enough to produce offspring.
5. Parasitism results from the struggle for survival.
6. Some parasites require more than one host in order to complete their life cycles.
7. Each germ disease is caused by a specific parasite.
8. The bodies of organisms have various natural defences against attacks by micro-organisms.
9. We can conserve human life by the application of scientific knowledge to prevention and treatment of disease.

Understandings	Suggested Scope and Procedures
1. Infectious diseases are caused by germs.	Learn about the contributions of Louis Pasteur and Robert Koch to the germ theory of disease.
	Observe types of bacteria under microscope.
	Demonstrate with culture plates the presence of bacteria in air, water, soil, etc., and the conditions favoring their growth and multiplication.
	Learn about diseases caused by molds, protozoa, round worms, flatworms, viruses and rickettsiae.
2. Some diseases are caused by failure of endocrine glands to function normally.	Learn the location, chief hormones produced by, and effect of improper functioning of the thyroid, parathyroid, thymus, adrenal, pituitary, pancreas, and sex glands.
3. Some diseases are caused by deficiencies in the diet.	Learn the causes of rickets, scurvy, beriberi, pellagra, night blindness.
4. Some diseases are due to hypersensitivity to certain foreign substances.	Learn about a few common allergies and their causes.
5. The animal body has certain natural defences against infection.	Study how the human body resists infection by (1) preventing entrance of germs; (2) destroying germs that have gained entrance; (3) counteracting the toxins.

Understandings	Suggested Scope and Procedures
6. Scientists have discovered the specific causes of many infectious diseases and how to control or treat these diseases. Some diseases are controlled by:	
a. Reducing the chances of becoming infected.	Learn how some diseases are controlled by (a) getting rid of carriers: flies, mosquitoes, fleas, lice; (b) sanitation, sterilization and pasteurization; (c) quarantine and isolation; (d) aseptic and antiseptic surgery.
b. Early diagnosis and treatment.	Learn diagnostic tests for tuberculosis, typhoid, diphtheria.
c. Increasing the body's resistance to infection.	Learn about the work of Jenner and Pasteur in connection with vaccination. Learn the types of substances used as vaccines and how they increase resistance to infection. Learn how diphtheria anti-toxin is produced.
d. Combatting the disease after infection is established.	Learn about the origin and use of quinine, atabrine, sulfa drugs. Learn about the discovery of penicillin, and a few more recent antibiotics, and some of their uses.

REFERENCES

Biology in Daily Life, pp. 277-354.
Elements of Biology, pp. 389-410.
Exploring Biology, pp. 245-316.
Modern Biology, pp. 559-606.

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

T544M	Man Against Microbes
T535	Immunization
T248	Man's Greatest Friend (Pasteur)
T246	The Story of Dr. Jenner
T187	Body Defences Against Disease

SCIENCE 32: UNIT VI—THE BEHAVIOR OF LIVING THINGS

OBJECTIVES

1. To give pupils the basic concepts necessary for understanding plant and animal behavior.
2. To give pupils an appreciation of their own nervous system.
3. To give pupils the understanding that behavior usually has definite causative factors and that man must study these causative factors in an effort to understand and control his own behavior.

GENERALIZATIONS

1. All living things react to stimuli.
2. Successful reactions make it possible for the organism to obtain its basic needs.
3. Most organisms are of such complexity that they need specialized structures to govern behavior.
4. Man's nervous system assures him of top place in the world of life.
5. Man's behavior is determined by his general physical condition, by his rate of growth, by his chemical balance, and by his nervous system.
6. An individual's behavior is limited by his heredity and greatly affected by his environment.
7. The character of the response is often determined by the efficiency of the sense organs.
8. Man can increase his efficiency by conditioning his behavior.

Understandings	Suggested Scope and Procedures
1. All living things react to stimuli.	Discuss behavior in a wide range of living things in non-technical terms. Try to identify stimuli and responses. Pick out examples of tropisms, reflexes, and voluntary behavior. Demonstrate wherever possible.
2. Successful reactions make it possible for the organism to obtain its basic needs.	Relate behavior to survival: securing food, oxygen, sunlight; conserving water; maintaining body temperature; protection; migration; hibernation; reproduction.
3. Most organisms are of such complexity that they need specialized structures to govern behavior.	Study structure and types of neurons. Study from dissections the main parts of the nervous systems of earthworm, grasshopper, and frog. Compare the nervous systems of hydra, planaria, earthworm, grasshopper, frog and man.
4. Man's nervous system assures him of top place in the world of life.	Consider the great variation of conditions to which man has adapted himself, and his superiority to larger, smaller, swifter, stronger, more prolific forms of life.

Understandings	Suggested Scope and Procedures
a. He is capable of great adaptability:	
i. He has a large number of possible pathways for nerve impulses to travel.	Compare the relative sizes of cerebral portions of the brains of various animals studied.
ii. His nerve control allows fluent speech and recording to pass on cultural heritage.	
iii. His most vital processes are automatic and allow him to concentrate on conscious behavior.	Study the central and automatic nervous systems, and their functions. Note some of man's reflexes.
iv. His nervous system is as well protected as are those of most vertebrates.	Examine skeletons of available vertebrates and note how skulls and vertebrae protect the nervous system.
v. Man learns by experience.	Study, in a general way, the areas of the brain, and relate to memory and reasoning.
b. His life need not be as "cheap" as if his behavior were largely automatic, and each man has a chance to develop more or less individuality.	Compare man with social insects, and other lower forms of life.
5. Man's behavior is determined by his general physical condition, by his rate of growth, by his chemical balance and by his nervous system.	
a. The development of the nervous system is affected by the glands due to the complex chemicals they secrete.	Consider the enrocrine glands and how their secretions modify behavior. Stress the inter-action among the glands.
b. Glands, in controlling the general metabolic rate of the whole body, speed up or slow down the activity of the nervous system.	
c. Growth rate greatly affects behavior, particularly during adolescent years.	Consider increase in length of arms, intestine, etc.; calcification of bones.
6. An individual's behavior is limited by his heredity and greatly affected by his environment.	Consider effect of environment in areas most productive of crime.

Understandings	Suggested Scope and Procedures
7. The character of the response is often determined by the efficiency of the sense organs.	Study the human organs of hearing, balance, pain, pressure, temperature, smell, taste. Compare these with organs of lower animals sensitive to vibrations, light, pressure and temperature changes, and chemical action. Pupils may check themselves for color-blindness, etc. Consider how man has supplemented his senses: hearing aids, spectacles, telescope, microscope, radar, etc.
8. Man can increase his efficiency by conditioning his behavior.	Discuss Pavlov's experiments on conditioning behavior.
a. Man learns by doing. Correct habits can only be learned by practicing them.	Relate to development of study habits and skills such as playing musical instruments, car driving, etc.
b. Bad habits are often best broken by substituting other good habits and interesting activities.	Note habit forming agencies in the community. Emphasize the importance of independent thinking and resistance to propaganda.
c. If man studies the way his behavior has been conditioned, he can often gain insight into his behavior in later life.	Consider some fears and prejudices, how they have been acquired, and how they may be overcome.

REFERENCES

Biology in Daily Life, pp. 355-427.

Elements of Biology, pp. 349-376.

Exploring Biology, pp. 317-360.

Modern Biology, pp. 514-534; 499-507.

FILMS

(Available from the Audio-Visual Aids Branch, Department of Education)

T530 Your Eyes

T395 Your Ears

T310 How the Eye Functions

T294 The Nervous System

T216 Reactions of Plants and Animals

T201 Endocrine Glands

SCIENCE 32: UNIT VII—REPRODUCTION OF LIVING THINGS

OBJECTIVES

1. To develop an understanding of the beginnings of life.
2. To learn the differences and similarities in the reproductive processes of plants and animals.
3. To learn something of the way nature has provided for the care of the young.
4. To study the elementary embryology of a few typical plants and animals.

GENERALIZATIONS

1. Reproduction is a universal and natural process in the biological world.
2. Reproduction is fundamentally the separating-off of a part of an organism to make another like itself.
3. A great variety of adaptations aid in the reproductive process.
4. Some plants and animals employ sexual methods, some asexual and some both. Sexual reproduction may occur in all but the lowest plants and animals.
5. Sexual reproduction involves fertilization.
6. Development from zygote to complex organism proceeds in regular and definite fashion very similar in all organisms.
7. Sex glands produce hormones as well as reproductive cells.
8. Number of offspring is in adverse proportion to the amount of parental care.

Understandings	Suggested Scope and Procedures
1. Reproduction is fundamentally the separating-off of part of an organism to make another like itself.	Demonstration to disprove spontaneous generation. Discussion of work of Redi, Spallanzani, Pasteur. Discuss life cycle of a few organisms such as horse-hair snake, frog, etc.
2. A great variety of methods are employed in the reproductive process.	
a. Asexual:	
i. Fission	Observe ameba and paramecium.
ii. Vegetative	Study grafting and budding, bulbs, corms, tubers, etc.
iii. Budding	Observe yeast and hydra.
iv. Spores	Observe black bread mold, mushroom, moss and fern sporophytes.
v. Regeneration	Study regeneration in planaria and starfish.
b. Sexual:	
i. Conjugation	Study conjugation in paramecia, desmids, black bread mold, spirogyra and ulothrix.
ii. Gametic	

Understandings	Suggested Scope and Procedures
3. Sexual reproduction involves fertilization.	
a. Origin of the sex cells.	Study from dissections the reproductive systems or structures in earthworms, grasshopper and frog.
i. Somatoplasm and germplasm.	
ii. Mitosis and meiosis.	Study and diagram the stages in mitosis and meiosis.
b. Significance of fertilization.	Learn how sex is determined in XY type.
	Distinguish spore, gamete, zygote.
4. Some invertebrates and most plants have an alternation of asexual and sexual generations.	Study the life-cycle of a jellyfish.
	Observe and study the life-cycle of a moss, a fern, and a flowering plant.
	Dissect one or more flowers and learn the parts and how fertilization is accomplished.
5. Plants and animals possess many adaptations related to reproduction.	Observe complete, perfect and imperfect flowers.
a. Adaptations to secure self- and cross-fertilization.	Observe and study adaptations in plants to secure self- or cross-pollination and fertilization.
b. Adaptations for spreading to new habitats.	Observe and study adaptations in plants to disseminate seeds.
c. Reproduction sometimes takes place from unfertilized eggs.	Study reproduction in aphids, bees.
6. Growth follows a definite pattern.	Study, and if possible observe, the development of frog or other amphibian eggs, and hen eggs.
a. zygote changes b. tissue origin c. organ and system formation.	Diagram the development of a vertebrate zygote through blastula and gastrula stages and note in a general way the origin of tissues from the three germ layers.
d. embryo and foetus	Study the development of the embryo and seed in a flowering plant.
e. oviparous, viviparous and ovoviviparous	Note examples of oviparous, viviparous, and ovoviviparous animals, and the relation of embryo to mother in each case.
7. The number of offspring is in adverse proportion to the amount of parental care.	Compare number of offspring and amount of parental care in some insects, fish, frogs, birds, domestic mammals and man. Note relation of care and number of offspring to chance of survival.

REFERENCES

Biology in Daily Life, pp. 428-464.

Elements of Biology, pp. 570-573.

Exploring Biology, pp. 361-422.

Modern Biology, pp. 170-195.

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

T610 Baby Animals (Parental Care)

T520 The Development of the Chick

T314 Reproduction Among Animals

SCIENCE 32: UNIT VIII—VARIATION AND HEREDITY

OBJECTIVES

1. To develop some understanding of the succession of living things through the ages.
2. To develop an understanding of the role of heredity in one's own environment.
3. To gain a knowledge of the units that carry the characteristics from parents to offspring.
4. To learn how the laws of heredity may be applied to plant and animal breeding and to the improvement of the human race.
5. To develop interest associated with the care of plants and animals.

GENERALIZATIONS

1. Records of life of past ages are obtained from the study of fossils.
2. The fossil evidence indicates that the kinds of plants and animals that inhabited the earth change in form and structure over long periods of time.
3. Every expressed character in an individual is the product of the interaction of genetic and environmental factors.
4. Variation is a universal phenomenon among living things.
5. Characters are usually inherited as units and are determined by genes carried in the chromosomes.
6. Evolution is a process consisting largely of the chance formation of new heredity factors and their loss or increase in frequency within a population.
7. Knowledge of the mechanism of heredity has made it possible to use a system of trial and error, and dependable prediction, in the production of new, more useful varieties of plants and animals.
8. The difference between one race and another is usually not a matter of the possession by one or another of certain unique characters.
9. Chromosomes may be altered by environmental factors so that mutations appear which suddenly show significant changes in form or character in one or more heritable characteristics in a single generation.
10. Success in the breeding of new and of more useful domesticated plants and animals rests upon knowledge of the mode of the inheritance of specific traits.

Understandings	Suggested Scope and Procedures
1. Living things in the world today are but a continuation of the life stream of the past.	
a. Fossils indicate that there has been a succession of living things on the earth beginning with the simplest forms.	Examine fossils and learn what they indicate to a biologist. Learn the eras of the earth's history and the types of living things dominant in each.
b. Man has changed in the past.	Compare anthropoids, Java Man, Heidelberg Man, Piltdown Man, Neanderthal Man, and Cro-Magnon Man (See **Elements of Biology**, p. 254; **Exploring Biology**, p. 483.)

Understandings	Suggested Scope and Procedures
c. There are several lines of evidence of changes in living things through the ages.	Consider briefly some examples of evidence from: 1. Succession of fossils; 2. Morphology—compare appendages of frog, bird, bat, whale, horse, man. 3. Embryology—compare embryos of fish, chicken, hog, man. 4. Vestigial structures—appendix. 5. Physiology—blood serum tests, etc.
2. Variation in plants and animals is a universal phenomenon.	Observe similarities and differences among humans—class and family; in domestic animals; in plants. Learn about De Vries' study of mutations, and some other mutations that have been important.
3. Changes in structure are often a useful factor in the survival of a species.	Note the theory of natural selection and survival of the fittest.
4. Inherited characteristics depend upon the genes.	Study Mendel's Laws and their application. Make checker board charts showing monohybrid and dihybrid ratios of phenotypes and genotypes. Study inheritance of eye-color, color-blindness, blood groups, Rh, etc., in man.
5. Every expressed character is the product of the interaction of genetic and environmental factors.	Note work of Lamarck and Weismann. Note evidence from studies of twins; the Kallikak, Jukes, Darwin or Galton families. Eugenics. Differences in human races. Grow plants under varying conditions of light and nutrients.
6. A knowledge of heredity has made it possible to breed new and improved varieties of plants and animals.	Learn what constitute "improvements": increased yield, better quality, extended range, disease resistance. Learn methods used to secure improved varieties: selection, inbreeding, hybridization. Study examples of application of each of these methods: Burbank potato, hybrid corn, Marquis and other wheats of western Canada.

REFERENCES

Biology in Daily Life, pp. 465-509.
Elements of Biology, pp. 575-588; 604-632.
Exploring Biology, pp. 423-504.
Modern Biology, pp. 607-668.

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

T428 Heredity
T309 The Story of Wheat

SCIENCE 32: UNIT IX—THE KINDS OF LIVING THINGS

(Some teachers may prefer to take this Unit immediately after Unit I or to disperse it among the other units.)

OBJECTIVES

1. To give the pupils an understanding of the important characteristics of the great groups of plants and animals.
2. To give pupils an understanding of the relationship of the great groups of plants and animals to one another.

GENERALIZATIONS

1. Animals can be divided into about ten phyla, all the members of each having certain characteristics in common.
2. The vertebrate sub-phylum can be divided into several classes, the members of each class having certain unique characteristics.
3. Plants can be divided into four phyla, each of which is subdivided into classes.
4. The higher forms of life are more complex in structure. This increase in complexity of structure is accompanied by an increase in division of labor.

Understandings	Suggested Scope and Procedures
1. Protozoa are the lowest form of animal life. 2. Porifera are porous bodied metazoans. 3. Coelenterata are animals with bag-like bodies. 4. Platyhelminthes are flat worms. 5. Nemathelminthes are round worms. 6. Echinodermata are spiny-skinned animals. 7. Annelida are segmented worms. 8. Mollusca are soft-bodied animals. 9. Arthropoda are animals with an exoskeleton and jointed appendages. 10. Chordata are the highest phylum of animals. 11. There are five important classes of vertebrates: a. Pisces b. Amphibia c. Reptilia d. Aves e. Mammalia	Study habitat, characteristics and relationship to man of each of the groups mentioned. Learn a few examples of each group. Examine some with microscope or otherwise. Relate complexity of structure to division of labor in each.

Understandings	Suggested Scope and Procedures
12. There are about a dozen orders of mammals: a. Monotremata (egg-laying) b. Marsupialia (pouched) c. Edentata (toothless) d. Insectivora (insect-eaters) e. Rodentia (gnawers) f. Ungulata (hoofed) g. Proboscidea (trunked) h. Chiroptera (flying) i. Cetacea (water habitat) j. Carnivora (flesh-eaters) k. Primates (erect)	
13. Thallophyta are the simplest plants—algae and fungi.	Examine under microscope: pleurococcus, diatoms, spirogyra, and any others available. Grow mold on bread or in culture. Examine black bread mold, mushroom, puffball, shelf fungi, and any parasitic fungi available.
14. Bryophyta were the first land plants.	Learn to recognize liverworts and mosses. Trace alternation of generations.
15. Pteridophyta were the first vascular plants.	Trace alternation of generations in fern.
16. Spermatophyta are the highest plants. They are either Gymnosperms or Angiosperms.	Learn to identify local trees and some other native plants.
17. Plants and animals have increased in complexity of structure and division of labor through the ages.	Learn a family tree of living things.

REFERENCES

Biology in Daily Life, pp. 513-569.
Elements of Biology, pp. 589-603.
Exploring Biology, pp. 27-112.
Modern Biology, pp. 219-424.

FILMS

(Obtainable from the Audio-Visual Aids Branch, Department of Education)

T602 Amoeba
T569 Paramecium (two reels)
T519 Life of a Freshwater Polyp
T501 Mammals of the Western Plains
T500 Mammals of the Rocky Mountains

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